[redacted]

[redacted] 3

SINGLE COPY ONLY

Accession No. 17999

Copy No. / [redacted]

SID 62-300-10

(Title Unclassified)

APOLLO MONTHLY PROGRESS REPORT
NAS9-150

4.5.4.1

1 March 1963

ASPO DISTRIBUTION COPY
Destroy when no longer in use
Do not return to ASPO file

Covering the Period From 16 January to 15 February 1963

CLASSIFICATION CHANGE

To UNCLASSIFIED
By authority of GDS - EO 11652 Date 12/31/72
Changed by
Classified Document Master Control Station, NASA
Scientific and Technical Information Facility

[redacted]

~~This document contains information affecting the national defense of the United States within the meaning of the Espionage Laws. Title 18 U.S.C. Section 793 and 794. Its transmission or revelation of its contents in any manner to an unauthorized person is prohibited by law.~~

NORTH AMERICAN AVIATION, INC.
SPACE and INFORMATION SYSTEMS DIVISION

[redacted]

[redacted]

CO[redacted]

CONTENTS

[redacted]

CO[redacted]

PROGRAM MANAGEMENT

STATUS SUMMARY

Press coverage was permitted at a firing of the launch escape motor; a successful fifth firing of the pitch control motor was accomplished.

Three consecutive tests of modified ringsail chutes were conducted. Unsatisfactory cluster operation in the ringsail parachute program has caused a backup program on solid parachute development to be initiated.

The reacton control subsystem (RCS) nozzle is being modified from a 40:1 to a 10:1 ratio. Single coil solenoid valves will be incorporated in the new design.

The lack of Avco heat shield production facilities approval will delay delivery of the end item.

All major construction work on the impact test facility is complete.

NASA structure inspection of boilerplate 6 was completed and final subsystems are being installed.

The service modules for boilerplates 13, 14, and 23 are on schedule, as are the adapters boilerplates 13 and 14.

The launch escape tower for boilerplate 9 was accepted by NASA. Interface and mating of boilerplate 9 command module, service module, adapter, and launch escape tower will begin during the next report period.

CONTRACTS

Special Test Equipment

A meeting is scheduled at S&ID on 25 and 26 February to negotiate contract coverage on those items of special test equipment (STE) that have been forwarded to NASA for review and justification of need and classification.

[redacted]

Documents Submitted to NASA

A firm cost proposal for the alternate heat shield system (parallel development program) was prepared.

A budgetary and planning estimate for implementing the NASA soldering specification was prepared.

A firm fixed price proposal to provide minimum security protection at WSMR from 15 February 1963 to 15 January 1964 was submitted to NASA.

A firm cost proposal for company furnished equipment (CFE) items to be procured at AEDC, AMR, WSMR, and Downey was submitted. An estimate for spares to support the CFE was also included in the proposal.

Contract Change Authority Actions

During the past report period, contract change board activities included review and approval of three preliminary contract change proposals; review of seven contract change proposals (CCP) initiated by contract change authorization (CCA); and review of eight CCP's for which seven CCA's have been requested.

Houston Meetings

Conferences have been held continuously in an attempt to definitize Letter Contract NAS9-150.

Subcontract Status

The negotiation bases for seven of the major subcontractors have been presented to NASA for review. During the next report period, six more subcontractor bases will be presented. Negotiations have been completed with three contractors, and contracts are being written. Target dates for the balance of the negotiations are as follows:

SUBCONTRACTOR	TARGET DATE
Aerojet	March 1963
AiResearch	February 1963
Collins	March 1963
Lockheed	February 1963
Marquardt	March 1963
Minneapolis-Honeywell	February 1963
Northrop-Ventura	March 1963
Pratt & Whitney	March 1963
Beech	February 1963
Douglas	March 1963

[redacted]

NEW PROCUREMENTS

During this report period, orders were placed with the Bell Aerospace Company for the positive expulsion tanks, with the Elgin National Watch Company for the central timing system, and with the Airborne Instrument Laboratories for the recovery antenna. Award of the contracts is being made subject to NASA approval. Following is a list of items to be ordered, together with their anticipated order dates:

ITEMS	TARGET DATE
Main propellant tanks	February 1963
Mission Simulator	March 1963
Radome	February 1963
2 KMC antenna	February 1963
Beacon antenna	February 1963
In-flight test system	March 1963
Propellant quantity indicating system	February 1963
Propellant gauging system	March 1963

DEVELOPMENT

TECHNOLOGY

Flight Performance and Control

The characteristic velocities available for successful abort from the translunar coast phase have been investigated. Design target weights plus propellant loadings that would provide a 10 percent ΔV margin were assumed for the spacecraft.

The study determined that the lunar excursion module propulsive stages alone can impart a ΔV of 2530 fps to such a spacecraft. This velocity increment is sufficient for a successful abort in the translunar coast phase if abort is initiated beyond 600 to 800 nautical miles from the earth.

By using the lunar excursion module propulsive stages, jettisoning them, and then using the service module propulsive stage, a maximum ΔV of 13,487 fps can be achieved.

Using revised MSFC Saturn 1 weight and performance data, it is possible to inject the Apollo spacecraft into earth orbit without using the service module for orbit injection. For lunar mission command and service module weight, a circular orbit altitude of 124 nautical miles can be achieved using a 72-degree launch azimuth. For reduced command-service module weights typical of the first manned orbital flight, a circular orbit altitude of about 160 nautical miles can be achieved. An adequate Saturn 1 booster performance margin exists to attain circular orbit, at a lower altitude, if one engine is inoperative in either boost stage during part of the boost trajectory.

The use of aerodynamic strakes has eliminated the command module hypersonic apex-forward trim point. Two alternate methods have also been evaluated. The first method consists of jettison of the launch escape subsystem (LES) ballast approximately 15 seconds after abort, followed by jettison of the tower and motors. The second method is jettison of the LES motors with the tower structure remaining attached to the command module. Neither approach eliminates the hypersonic apex-forward characteristic.

[redacted]

The over-all effectiveness of the flow separator in improving LES stability and performance was reevaluated since the command module center of gravity was moved forward. Dynamic stability studies, conducted with current weight and aerodynamic data, revealed that the LES without a flow separator would require very little ballast. Because of this finding, S&ID has recommended deletion of the flow separator from the LES.

An evaluation of the LES has shown that satisfactory separation between Little Joe II and the spacecraft will not occur if thrust termination is not provided upon initiation of the abort.

To establish fuel consumption criteria, a model steering method for transfer of the command module from its parking orbit to the lunar excursion module parking orbit for emergency rendezvous was simulated with the IBM 7090 computer.

Analysis of the computer program revealed that the model yielded miss-distances of approximately 100 feet and that spacecraft fuel consumption varied widely.

The spacecraft in initiating this maneuver in the coplanar case would require 600 pounds of fuel; in the non-coplanar case, it would consume 2200 pounds. In terminating the maneuver, the spacecraft would consume equivalent quantities of fuel to eliminate the ΔV.

The model studied is an extreme design and not necessarily one that will be used in a real mission.

A possible mechanization of radar information for rendezvous operations has been established. Preliminary results show that range data with a 1 percent accuracy is sufficient for the terminal phase but only marginally sufficient for midcourse corrections, depending on the noise-spectrum width.

Thermodynamics and Fluid Dynamics

A plate to simulate service module aft bulkhead heating was designed. The plate was tested during the AEDC subscale service propulsion subsystem (SPS) engine tests. Data from the tests are being evaluated to determine heating effects on the bulkhead from the columbium-titanium nozzle skirt. These data are to be correlated with the full-scale engine bulkhead heating calculations.

A pretest conference with NASA resulted in the following clarifications of test requirements.

S&ID and NASA conferred to clarify jet plume test requirements. The conference resulted in S&ID request for additional cryoplates in the test cell to meet the required altitude capability, consideration of a change of test scope and of rescheduling the test period of Phase III, and NASA request for an additional molybdenum chamber for Phase II testing.

Criteria for predicting the spacecraft/S-IV booster separation distance required for firing the SPS engine during abort were determined. Safe firing will result when the jet interaction shock is positioned external to the nozzle.

Studies of both series and parallel connected SPS tank configurations show that use of the parallel system does not provide sufficient advantages to change from the present series arrangement at this time.

Entry heating rates for 32 additional command module body locations were prepared for five entry trajectories. Heating rates and loads during launch and entry were determined for the following:

1. Lunar excursion module adapter
2. Radiation deflector below the service module reaction control subsystem (RCS) nozzles
3. Service module for five entry trajectories
4. Service module RCS package during boilerplates 13, 15, 16, and 18 boost
5. Shear stresses on the aft heat shield for two cases of entry from earth orbit.

Agreement on convective heating rate prediction has been established between the NASA, Ames, Langley, and S&ID methods of determining command module entry heating rates.

Heat transfer analysis of outer surface and structure temperatures shows that with the lunar excursion module in the docked position, a small deviation from a specified orientation history will either violate communications requirements or result in structure temperatures lower than -100 F.

The materials evaluation portion of the alternate heat shield test program was completed. Rocketdyne completed a computer program for statistical regression of the data. This program was combined with an S&ID conduction program to determine heat-soak results and proper insulation sizing. The results of the thermal screening effort were presented to MSC.

A problem exists during the separation of the launch escape vehicle from a thrusting Little Joe II booster at high dynamic pressures and from the Saturn 1 booster at Mach number 1.0.

Estimates of on-board coolant requirements for boilerplate 22 indicate that two coldplate coolant systems may be necessary to maintain an 80 to 110 F coldplate temperature range for stabilization and control system equipment and to provide a maximum coolant temperature of 56 F out of the heat exchanger.

Analysis of preliminary data for a nominal 14-day mission reveals that delivery gas temperatures of the cryogenic oxygen range from 178 R to 317 R at the end of transearth coast. Because a 350 R delivery temperature is required, a preheater probably will be required for all mission phases.

A radiation shielding verification program was presented to NASA for review. NASA has recommended that S&ID study solar proton warning techniques and associated radiation monitor display systems. Type IV solar radio frequency noise emission has been found to precede flare activity by 15 to 30 minutes. Therefore, the size of an event probably can be determined well before it is experienced at the spacecraft.

<u>Life Systems (Crew Provisions)</u>

Comparisons of 6-volt and 28-volt floodlighting systems have been completed. The results show that for a 340-hour mission the 6-volt system consumes 7000 watts less power than the 28-volt system.

The SY-1 Simulation (Phase II - Orbital Attitude Control) was completed. Results indicate that the crew can manually operate the stabilization and control subsystem (SCS) during an emergency manual mode, with an acceptable economy of fuel.

A low-pressure chamber for a spacesuit arm simulator was completed and successfully pressure tested to a 3.5 psi differential.

A preliminary evaluation of a window cover crank mock-up was completed using a Mercury-type glove mounted on a Mark IV suit sleeve. This simulator will be used for further mock-up evaluations of controls and demonstrations of Apollo pressure suit flexibility.

Tests have been conducted to evaluate crew spatial mobility and visual requirements for GSE carry-on equipment. As a result, preliminary recommendations have been made for the arrangement and placement of this equipment.

Crew performance requirements for a ten-day simulated earth orbital mission were developed. The primary purpose of this simulation is the checkout of biomedical apparatus and food, but some human performance data, such as reaction times and count of omission errors, are possible from the simulation.

Simulation and Trainers

Design of a simulated fuel accounting system is nearing completion. The system furnishes an accounting of fuel used during a mission by maintaining a constant record of the total fuel used by each engine.

The interior of the command module of evaluator 1 is being modified to the latest configuration for the rendezvous study. A new control and display panel and new wiring are being installed.

A problem description of the all-digital entry system is nearing completion. This description was developed to evaluate digital simulation techniques, with specific application to the IBM 7090 digital computer and equipment tie-in problems.

Satisfactory progress was made in a program to develop mechanizations for computer simulation of portions of the missions. These space flight phase simulations will last 10 to 20 minutes. The mechanizations include S&ID-designed and developed digital logic boards to simulate the SCS. All submechanizations except the guidance equations have been checked out.

An investigation of the effects of blowdown transients on the service module propulsion system was completed. One effect was a mass unbalance in the fuel/oxidizer ratio. Analysis of the results shows that this unbalance must be corrected by either manual or automatic propellant utilization.

NASA approvals were received for the Apollo part-task trainer development report and the budgetary and planning estimate for this trainer.

Structural Dynamics

Landing Impact and Stability

Three drop tests with a horizontal velocity component were made with boilerplate 1, the most significant of which involved a pitch angle of -30 degrees. Analyses and tests to date indicate that moderate pitch angles of 0 to ±15 degrees produce high loads on the command module structure and the couch support system under many nominal landing conditions. The extreme pitch angle of -30 degrees produced a violent landing, with severe tumbling of the vehicle. Loads, however, were comparatively low on both the basic structure and the couch system.

The digital computer analysis program is being revised to account for large rotations during the landing phase. Additional degrees of freedom are being added to handle translations in the lateral (yaw) direction. Analyses are planned in support of the boilerplate drop tests that will be directed towards further study of the -30-degree pitch condition.

Flotation Stability

The second 1/10 scale flotation model has been fabricated. Preliminary static tests of this model revealed close agreement with analysis on the flotation heel angles for both stable positions of the flooded vehicle.

Model Calculations

Initial calculations were made on the natural modes and frequencies of the lunar excursion module-spacecraft combination to support an analysis of the vehicle control system.

Structural Vibration and Acoustics

Acoustic tests on command module structural panels revealed that transmission loss through the panels is very close to the calculated value but that the vibration response is generally higher than anticipated. Further tests are planned on various types of panels, using both reverberant chamber facilities and traveling wave excitation.

Noise Rating Program

A study was initiated to calculate the noise generated by systems such as fans, fluid flow in ducts, and motors. Because of established noise-limit levels, the contribution of each individual item will be considered in determining the over-all noise level in the command module.

Dynamic Measurements

Discussions were held with NASA representatives to determine final requirements for vibration and acoustic measurements on boilerplates 13 and 15. There are still some unresolved areas requiring direction from NASA.

SPACECRAFT AND TEST VEHICLES

Structures

Redesign of parachute fittings and gusset supports accomplished the twofold objective of saving weight and easing manufacture of the items. A 22.8-pound weight saving is shown in new drawings released for manufacturing.

As directed by NASA, the deep space instrumentation facility antenna was relocated so that it is in line with the astronaut's field of vision.

Tests to determine the effects of radiation exposure on charring ablator specimens revealed that Thermolag T-500 has significantly higher residual radiation characteristics than two other candidate materials.

Northrop-Ventura performed parachute subsystem drop 24 on 8 February to determine the effects a one-second disreefing differential would have on two parachutes.

Design studies of the current impact attenuation system reveal that the crew emergency limits will be exceeded under ideal (controlled) spacecraft conditions in 5 percent of all ground landings. In March, a boilerplate test program will be conducted at the impact facility to determine whether deceleration g levels can be lessened by increasing the command module impact attitude angle.

S&ID and MIT reached agreement on all mechanical interfaces for the navigation and guidance equipment.

Guidance and Control

Preparation was begun on interface coordination documents to govern the stabilization and control subsystem/service propulsion subsystem interfaces. Three documents will govern the following interfaces: thrust vector control signals, thrust vector control position indication signals, and service propulsion subsystem engine on-off signals. Preliminary interface coordination documents were prepared for use during an upcoming meeting between S&ID, Minneapolis-Honeywell, and Aerojet-General for discussion of interface problems. To date, 57 interface coordination documents have been identified between S&ID and MIT; of these, 31 are in the process of being detailed, and approximately 20 are nearing completion.

A design base was established at a "design-freeze" meeting on the stabilization and control subsystem displays and controls.

Telecommunication and Instrumentation

Telecommunications

Because of three traveling wave tube failures, an alternate supplier is being sought. Other types of power amplifiers are also being investigated.

The up-data link study is expected to be completed on schedule. This is a NASA-requested trade-off study to determine the spacecraft up-data link interfaces for the following:

1. On-board display of data with manual insertion of the data into the spacecraft systems

2. Direct input of the data into the guidance computer

3. Direct input of the data to the SCS.

S&ID anticipates that spacecraft needs and equipment delivery dates will be incompatible because of the time needed for NASA evaluation and for the establishment of equipment requirements.

Increase of the pulse code modulation telemetry rate from 32,000 to 51,200 bits per second is being investigated to satisfy the prelaunch automatic checkout equipment interleaver synchronization problem without reducing the measurement channel capability of the pulse code modulation telemetry. This increase in bit rate would also enable the accommodation of the spacecraft 009 qualification measurements by a temporary increase in components instead of the heavier alternative of adding PAM-FM/FM telemetry equipment.

Instrumentation

The R & D instrumentation installation design for boilerplate 6 is 90 percent complete and incorporates changes and relocations made necessary by the addition of aerodynamic strakes to the command module.

All flight instrumentation for boilerplate 6, except the tape recorder, has been qualified. The tape recorder, which is NASA-furnished, was found to be defective and was returned to NASA for repairs. The qualified instrumentation is being readied for installation into boilerplate 6.

Pressure transducers for boilerplate 12 are being calibrated. Installation design for this boilerplate is 97 percent complete, and for boilerplate 13, 85 percent complete.

Development of operational instrumentation systems continues to be hampered by lack of firm definition of a measurement requirements list. Continued efforts are producing achievements in selection of, specification for, and installation of operational instrumentation for which sensor requirements are known.

Environmental Control Subsystem (ECS)

At the request of S&ID, AiResearch has submitted a new cost proposal for the ECS. This proposal reflects the cost of manufacture and development of the ECS and associated GSE, as required by the updated statement of work for the subcontractor. It does not, however, present costs of ECS reliability testing (which includes qualification tests), because the basic ground rules and detailed requirements for the qualification test program are yet to be resolved.

S&ID has directed AiResearch to repackage the ECS to improve center-of-gravity for the capsule. Several ECS components and packages are being redesigned to withstand an increase in shock load requirements brought about by deletion of the impact attenuation system. This repackaging will increase the ECS weight by approximately 14 pounds. The new package weight will be within the 221-pound limit for the system.

The ECS hardlines, as well as the electrical wiring and coaxial cables, that originally passed between the two modules through the heat shield were rerouted along the outside of the spacecraft. This rerouting was necessary because of the large opening left in the heat shield after the modules separate during entry. Because of this redesign, S&ID assumed responsibility for the water-glycol, oxygen, and water quick disconnects and removed these items for the subcontractor's ECS tasks.

Electrical Power

Spacecraft battery design studies resulted in a simpler, lighter, and smaller battery. Effort has been initiated to provide a separate pyrotechnic battery system. A study was begun to determine a means of charging the spacesuit backpack battery by using the spacecraft charger.

The cryogenic circuitry is being redesigned to provide multiple load-level switching of heaters to satisfy normal or emergency conditions without excessive transients.

Two parallel fuel cell installation designs are in progress for hardline and mount location to resolve installation difficulties in Bay IV of the service module.

The development test plan for the electrical power subsystem (EPS) radiator has been completed.

Design of the sequencer for boilerplate 14 and all spacecraft is 50 percent complete. This sequencer design uses solid-state logic and motor-driven switches.

To size the capacity of the EPS, an electrical load analysis was programmed on the IBM 7090, using data available as of 15 January 1963. Data for total a-c and d-c load profile (maximum, minimum, and average load) and energy consumed during each flight phase were computed.

Space Ordnance Systems and Hi-Shear have been selected as hot-wire initiator suppliers. Contract negotiations with Westinghouse for the inverter have been completed, and a delivery schedule compatible with end-item requirements has been established.

Displays and Controls

S&ID is still awaiting NASA approval of the in-flight test system (IFTS) requirements and procurement specifications. Preparations are under way for an IFTS workshop at which the IFTS concept will be reviewed with NASA.

A new configuration for the rotational hand controller has been completed. This new design meets the volumetric requirements of both the seat installation and the lower equipment bay installation.

Design concepts of a standard electronic system package have been completed. Fabrication of test models is under way to verify the structural integrity of this vertical, coldplate configuration for installation of the electronic systems in the lower equipment bay.

Design and coordination of the display and control consoles have produced standardized components. This standardization consists of common and mounted configurations for all front panel hardware. Specifications for all display and control components, as well as those items which will be purchased as subassemblies, have been started.

Service Propulsion Subsystem

Service Propulsion Engine

The second phase of the subscale test program at AEDC was completed by 15 firings of five different engine assemblies. A stiffened titanium nozzle extension buckled after 15 seconds operation. An Avco chamber failed after 318 seconds operation because of lamination separation downstream of the throat. A nozzle extension made of uncoated columbium and titanium was fired for 120 seconds. The columbium cracked at the columbium-to-columbium weld joint, and the nozzle separated during the subsequent start sequence prior to firing. Metallurgical analysis of the nozzle is in progress.

The first full-scale firing at Sacramento and seven subscale firings at Azusa were accomplished to determine the characteristic velocity. Forty-seven firings were made in the injector development program.

Service Propulsion Propellant System

The propellant distribution system lines have been rerouted to relocate the deep space instrumentation antenna. The tank-to-tank fuel transfer line was increased from 2 to 2-1/2 inches in diameter to balance oxidizer-fuel pressure differentials in the respective standpipes. Propellant system-engine interface locations have been resolved.

All four propellant tanks have been mounted on the F-3 test fixture, and mock-up plumbing is being installed. The F-3 pressurization system equipment package was tested and was found acceptable.

Reaction Control Subsystem (RCS)

Reaction Control Engines

Two-coil propellant valves are being incorporated on the command module and service module RCS engines. The command module RCS engines will be redesigned to incorporate a 10:1 nozzle expansion ratio. Heat transfer and char depth studies are being conducted by Rocketdyne to establish the engine envelope in the expansion nozzle area.

Test firings of service module RCS engines at Marquardt indicate that specific impulse is approximately 1 percent too low during steady-state operation. Improvement of specific impulse is being investigated.

Vibration and humidity tests were conducted on prototype three-coil valve engines. A minimum impulse bit of 0.15 pounds per second was achieved on an engine with a two-coil valve.

Reaction Control Propellant Systems

The command module and service module helium tanks have been changed to reflect identical configurations, simplifying production factors. The propellant tanks of both modules will be of equal diameter with varied lengths, so that the required propellant quantities will be accommodated.

All six engines of the command module RCS breadboard test stand and the four engines of the service module breadboard RCS were operated successfully.

Launch Escape Subsystem

Launch Escape Motor

Two launch escape motors were static tested at 140 F and at 70 F, after temperature cycling and under simulated altitude ignition conditions. The tests were unsuccessful; however, they were conducted with an igniter developed to serve as interim hardware until design is complete for an igniter that will bring thrust rise time within specification limits.

Tower Jettison Motor

One tower jettison motor was static-fired successfully at 70 F after having been temperature cycled. Two motors were shipped to AEDC for simulated altitude testing.

Pitch Control Motor

The first low-impulse pitch control motor (1550 pounds per second, total impulse), intended for boilerplate 6, was cast.

INTEGRATION

Systems Integration

Preparation of engineering test requirements documentation for each spacecraft is continuing. Preliminary documents for boilerplates 9, 12, 16, and 18 have been released. Documents for boilerplates 14 and 15 and spacecraft 008 and 009 are being released.

Preliminary lists of the sequenced operations necessary to check out each of the spacecraft systems were prepared and published. These lists, together with their accompanying list of precheckout requirements and basic system descriptions, will be used in the design of the prelaunch automatic checkout equipment (PACE) and the preparation of integrated systems checkout documents.

S&ID briefed members of the mechanical system panel on the results of the transposition and docking and crew transfer study. Panel members concurred in the S&ID recommendation to use the free-flyaround technique to accomplish transposition and docking. S&ID also presented the design criteria for docking mechanism developed from simulation activities at NAA-Columbus.

The meeting also produced tentative agreement between NASA, S&ID, and Grumman to adopt NASA-drafted ground rules and criteria for use in the design of docking mechanisms. In an effort to achieve lower design weights, S&ID and Grumman will develop predesign docking systems for presentation at the March mechanical systems meeting.

Interface coordination documents defining interfaces between the Saturn booster and boilerplate 9 (dynamic test) and between the booster and boilerplate 13 were submitted to the third meeting of the Saturn/Apollo mechanical integration panel. The panel agreed to adopt these as the official interface documents on an interim basis until NASA implements some other system.

The lunar excursion module interface and performance specification is being prepared for release. This specification defines the physical, functional, environmental and performance, support, and operating interfaces, as well as the contractor responsibility breakdown between the lunar excursion module and the other spacecraft modules. The non-design interface requirements are differentiated from the design requirements.

Ground Support Equipment

A GSE checkout trailer has been fabricated to replace the transfer room at WSMR. The transfer room could not be completed in time to meet the schedule for boilerplate 6. Documentation defining modification of the GSE for this changed installation has been completed.

The facility requirements for the prelaunch automatic checkout equipment-spacecraft control room equipment were determined to be 180 square feet of floor space, 13.3 kilowatts of power, and 4 tons of cooling. The requirements are the same for control rooms at Downey and at AMR.

A detailed design review of subcontracted GSE items established dates when equipment design would be ready for NASA review. Present costs, schedules, drawings, and technical details were discussed in the review.

Meetings were held at MSC and AMR to define the communications and data bench maintenance GSE. S&ID received lists of equipment presently on hand or scheduled to be on hand at AMR with a suggestion that this equipment be integrated into the Apollo bench maintenance GSE.

Review of the subcontracted rocket engine GSE will be completed.

Technical Operations

Authorization has been received to provide a GSE checkout van. This change, by elimination of the underground transfer room at the launch complex and by use of an additional van to house the GSE equipment affected, facilitates the launch schedule for boilerplate 6.

Authorization also has been received for the design of a command module RCS engine expansion ratio of 10:1. S&ID recommended this change to gain weight savings of approximately 33 pounds.

Direction has been received to implement a backup solid parachute development program with a company other than Northrop-Ventura to run concurrently with the current ringsail chute program. Tests of the ringsail canopy indicate unsatisfactory cluster operation. A parallel development program is necessary to determine the most desirable configuration for the earth landing subsystem.

Convair has been granted responsibility for the umbilical cable and J-box on the Little Joe II launch tower at WSMR. This change will eliminate major technical and interface control problems.

S&ID has been authorized to modify and adjust NASA-furnished R & D instrumentation. A clarification is being requested from NASA to obtain an adequate description of what the S&ID intended scope of effort should be.

LOR Mission Reliability Apportionment

Objectives for probability of mission success during a lunar orbital rendezvous (LOR) flight plan have been apportioned to the spacecraft and all related subsystems. The apportionments were derived from the Monte Carlo mathematical model and are predicated upon a 95 percent reliable booster, a 98.4 percent reliable lunar excursion module (both assigned by NASA), redundancy, alternate modes of operation, and the on-board spares defined to date.

To achieve the over-all mission objective, the apportionment for the command module, service module, and adapter had to be increased from the previous value of 0.96 for the direct lunar landing mission to 0.965 for the current mission.

Apportioned subsystems reliabilities also were significantly increased.

The apportioned reliability of the combined electro-mechanical systems (0.994845) can be achieved within current weight limitations. Electronic systems require approximately five additional critical spares (approximately 40 pounds of black boxes) to achieve the allocated reliability of 0.97. Reasonable application of Minuteman parts in the guidance system could increase its reliability from the 0.988901 figure to 0.996381, and at the same same time eliminate the need for a spare coupling display unit (6 pounds).

~~CONFIDENTIAL~~

Complete details of the S&ID apportionment study to the black box level are included in the Fourth Quarterly Reliability Status Report.

Reliability-Crew Safety Design Review

The second Apollo review was held concerning the earth landing subsystem.

[redacted]

OPERATIONS

DOWNEY

A formal program and facility presentation on the proposed Downey space chamber was given to NASA by Apollo test and operations, facilities, and program management personnel. At this meeting no firm decisions were made in favor of the chamber. A second meeting was held to clarify program needs. A decision was made at this meeting that the bell-jar will be the only type of Apollo environmental chamber constructed at the Downey facility.

During a meeting held at Houston, firm decisions were made on a number of items of GSE and BME support requirements for spacecraft 008. A majority of the items were deferred pending further program definition.

The detailed test plan of environmental proof tests was revised and updated for inclusion in Volume V of the General Test Plan. Significant changes included a more comprehensive and realistic number of instrumentation measurements.

The house spacecraft portion of the General Test Plan has been revised and will contain the following information: a detailed test plan for GSE, a list of GSE for boilerplate 14, a test logic chart for each boilerplate system, a description of each test logic chart, the boilerplate 14 definition documents, and schedule changes.

The house spacecraft test plan also outlines GSE usage from delivery through installation, item-by-item facility compatibility checkout, system/GSE integration checkout, combined systems test unit (CSTU) development, prelaunch automatic checkout equipment (PACE) integration, and GSE as a complete and integrated system. The plan defines the tests and portrays the schedules for the house spacecraft GSE effort.

In accordance with the NASA request, a general instrumentation flow and control plan for the NASA-furnished research and development instrumentation equipment was forwarded to NASA. This was only a proposed plan incorporating procedures and methods that will closely reflect the final released policies and procedures.

The three Chrysler consoles have been checked out and integral equipment calibrated. The boilerplate 6 instrumentation breadboard has been checked out with the exception of the flight recorder, which has been returned to Houston for flight qualification. The recorder will be returned to Downey after flight qualification by NASA.

Additional effort will be expended to finalize a data measurement list, along with data acquisition equipment requirements for spacecraft 008. Effort also will be expended to finalize GSE, BME requirements, and environmental test facilities.

The checkout procedures for boilerplate 6 will be completed and validated. Checkout procedures have been initiated for boilerplates 12 and 13.

Further study will be devoted to test facilities at Downey, the PACE concept and its application, detailed test planning for GSE facility checkout in the test areas, and facility requirements for checkout of the F-2 propulsion fixture.

The feasibility of a wide-band data link between the propulsion development facility at Las Cruces and the Downey Apollo data station is being investigated. Bell Systems is developing a data set that will accept serialized d-c binary data on a synchronous basis at 40.8K bits per second. The station equipment necessary to interface with the Bell equipment is being studied.

WHITE SANDS MISSILE RANGE OPERATIONS

The concept of using a combined instrumentation and GSE trailer (transfer trailer) has been dropped in favor of using individual trailers. NASA is supplying the instrumentation trailer, and S&ID has purchased the GSE trailer.

The major problems remaining unsolved in meeting the schedule on boilerplate 6 are the delivery of the launch escape tower and the procurement of explosive bolts. An additional problem occurring because of the deletion of the transfer room from the WSMR facilities design can be solved with the approval of additional manhours; a contract change authorization (CCA) has been submitted to obtain the additional manhours.

Formal direction concerning the manned, mated safety provisions for spacecraft 001 was received from NASA. A master change record (MCR) was released for design of a method to hold the command module in place—or remove by crane in an emergency. The design proposal is to be completed by the end of February.

On-site distances were determined by meetings and an inspection of the propulsion test facility. A request for approval was submitted to NASA. NASA has stated informally that the distances are satisfactory and that official approval documentation is forthcoming.

The GSE requirements list for spacecraft 001 has been completed. In addition, the GSE operational concept report for the F-2 fixture and spacecraft 001 has been completed and will be published during the next report period.

The data acquisition system specification and job order were completed and submitted to NASA for approval. ATO is following up with a briefing for NASA-WSMR, and a meeting to discuss the data acquisition system is scheduled.

During the next report period, effort will be directed toward completing requirements for the GSE operational concept report, continuing detailed scheduling of the test plan requirements, completing the facility back-up plan for support of Apollo service propulsion testing, continuing follow-up on data acquisition approval and implementation, preparing operational test procedures for the telemetry trailer, planning the buildup of the telemetry trailer, preparing the detailed test plan for boilerplate 22, and revising the detailed test plan for boilerplate 12.

ATLANTIC MISSILE RANGE OPERATIONS

The first revision of the program requirements document has been completed. This revision, reflecting those range requirements needed for the support of the Saturn 1 unmanned test vehicles, has been transmitted to NASA.

A joint study by ATO and Apollo engineering to investigate the requirements and the use for a separate end-to-end phasing test fixture for a mated command-service module configuration and a cleaning positioner for the command module only has been completed. The results of this study will be presented to NASA at the GSE coordination meeting.

The PERT networks for spacecraft 009 and 011 will be modified to reflect current test planning and checkout operations. Approval of these networks will be obtained during the next period.

Equipment layouts will be prepared for each of the Merritt Island facilities.

LOGISTICS SUPPORT

Training

Contract negotiations concerning training and trainers were conducted at MSC during late January. Requirements for part-task trainers, mission simulators, and course-supporting instructor handbooks were established. Progress on production of instructor handbooks will be delayed pending S&ID/NASA agreement on the detailed contents and format. Agreements reached during these negotiations caused revision of the Training Plan, dated 1 February 1963. These revisions will be reflected in the 1 March reissue of the plan.

Supply Support

A method of spares and GSE provisioning was established as a result of the NASA/S&ID contract negotiations at MSC.

A site support list for WSMR will be submitted to NASA about 1 March 1963.

The recommended spares list for support of the R&D instrumentation checkout console will be sent to NASA-MSC for approval.

Logistic Engineering

Information developed from life systems studies on in-flight maintenance and reliability engineering studies on the probability of failure makes it necessary to rewrite the reliability section of the in-flight maintenance concept.

The February GSE planning and requirements document will reflect an extensive revision. This was brought about by program schedule revisions and the current NASA decision on quantities and models of GSE.

A compatibility study of GSE for support of boilerplates and spacecraft is in process. This study will identify those items of GSE to be modified to support succeeding and more sophisticated test vehicles, boilerplates, and spacecraft.

Support Manuals

A positive requirement to provide support manuals to support qualification tests of boilerplate systems was received during the report period, initiating preparation of the following manuals for boilerplate 6 by 15 March 1963:

Spacecraft Description

Launch Escape Subsystem Maintenance

Earth Landing Subsystem Maintenance

GSE Maintenance Manuals For Select Major End Items

The transportation and handling manual is in final production and will be sent to NASA during the next report period.

FACILITIES

DOWNEY

Management and Engineering Areas

Construction work has begun on offices for Apollo Management and will be completed during the next report period.

Subcontractor Coordination

The revised facilities appendix for Avco was submitted to NASA. Joint NAA, NASA, and Avco meetings were held to resolve NASA questions on the remaining Avco items. Additional funding was approved by NASA for Collins Radio and Minneapolis-Honeywell. Of the interim supply contract funds allocated by NASA for subcontractor facilities, $1,617,685 has been committed.

Rehabilitation of the parachute packing facility at El Centro, California, was completed. All remaining rehabilitation work at this location will be completed during the next report period.

Plant Layout, Area Planning and Administration

Area plans have been resolved that will implement the recent management decision to remove all Apollo mock-up work to the research and development shop.

A new, single-point expediting system for handling urgent Apollo job orders was instituted.

Test Systems and Manufacturing Support

The necessary modifications to the test tower have been completed for total stacking of boilerplate 9.

Bids on the 18-foot diameter vacuum chamber were received, and evaluation of these bids is in process.

A screening appendix (Volume IV) review meeting was held with NASA. All items except two were tentatively approved.

The special autoclave will be delivered to S&ID and the standard autoclave will be relocated to the Bonding Building during the next report period.

Facilities Projects

Steel erection and general construction of the bonding and test facility is progressing on schedule.

All major construction work on the impact test facility is complete. A preliminary inspection by representatives of NASA, architectural and engineering, and S&ID has been held. The facility will be totally completed, inspected, and ready for operation during the next report period.

Phase I design submittals for the space system development facility have been received from architectural and engineering. Phase II design is proceeding.

All interior work has been completed on the plaster master facility. Exterior work will be completed within the next report period.

WHITE SANDS MISSILE RANGE

The third water test well at the propulsion system development facility has been drilled and tested.

The master planning study for the propulsion system development facility is 70 percent complete; the soil and foundation investigation is 80 percent complete.

The revised specification and technical proposal for the data acquisition system for the propulsion system development facility is expected to be approved during the next report period.